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Assessment of Wild Trout Populations in Blair Gap Run, Allegheny Portage Railroad National Historic Site

Natural Resources Technical Report NPS/NER/NRTR--2006/067

ON THE COVER
Introduced brown trout (*Salmo trutta*, top) and native brook trout (*Salvelinus fontinalis*, bottom) from Blair Gap Run, Allegheny Portage Railroad National Historic Site. Photographs by Caleb Tzilkowski

Assessment of Wild Trout Populations in Blair Gap Run, Allegheny Portage Railroad National Historic Site

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Executive Summary

The National Park Service (NPS) has an interest in preserving native brook trout in sections of Blair Gap Run (BGR) that occur on Allegheny Portage Railroad National Historic Site (ALPO) property. During a recent survey (Sheeder and Tzilkowski 2006), brook trout, and not brown trout were captured on ALPO property above the Blair Gap Reservoir, whereas both species were captured on ALPO property downstream of the reservoir. Those results suggested that the impoundment provided a barrier to upstream migration of nonnative brown trout.

Electrofishing surveys were conducted at five sites in BGR near ALPO to assess wild trout populations upstream of the BGR confluence with Blair Run. The primary intent of this survey was to determine the upstream limit of brown trout in BGR. The five sampled sites were located on a section of BGR owned by the Altoona City Water Authority between BGR sections that flow through NPS property (permission for sampling granted by Mark Perry, General Manager, Altoona City Water Authority).

Brook trout were captured at all sites whereas brown trout were not captured or seen above the Blair Gap Reservoir in this survey. These findings were consistent with those of Sheeder and Tzilkowski (2006) and supported the hypothesis that Blair Gap Reservoir is a barrier to upstream movement of brown trout. Moreover, brown trout were less abundant than brook trout where they coexisted in BGR. Comparison of trout densities in BGR to densities in two other central Pennsylvania streams (Tomtit Run and Lingle Run; Tzilkowski 2005) that were classified as Class A mixed wild brook and brown trout waters suggested that BGR upstream of Blair Run may qualify as a Class A brook trout water but probably not as a Class A mixed brook and brown trout water.

This study, in combination with results of the Sheeder and Tzilkowski (2006) survey, suggested that BGR likely deserves to have its Pennsylvania Department of Environmental Protection protected water use redesignated to more stringent levels of protection downstream of the Plane Nine Reservoir (from Trout Stocking to Coldwater Fishes). Based on trout densities, BGR may also deserve redesignation from Cold Water Fishes to High Quality-Cold Water Fishes upstream of the Plane Nine Reservoir. Because introduced trout are known to have detrimental effects on native organisms, including native trout, termination of trout stocking in upstream sections of BGR would likely aid the NPS goal of preserving brook trout while still providing a rewarding recreational fishery in BGR.

Introduction

Brook trout (*Salvelinus fontinalis*) is the Pennsylvania state fish and is native to the Commonwealth and much of eastern North America. Conversely, brown trout (*Salmo trutta*) is a European native that has been widely introduced throughout Pennsylvania and North America. From those introductions, wild (i.e., naturalized) brown trout populations have been established across the continent. Introduced trout often have detrimental effects on native organisms (Lassuy 1995) and because brown trout has been propagated and established so successfully during the past 120 years, it is implicated as a primary cause of native brook trout declines (Fausch and White 1981; Behnke 2002).

The National Park Service (NPS), including Allegheny Portage Railroad National Historic Site (ALPO), has a specific interest, and is directed by policy, to preserve native species such as brook trout. During a recent water quality survey and fish and macroinvertebrate inventory at ALPO (Sheeder and Tzilkowski 2006), wild-spawned trout were captured at four sampling sites on the Blair Gap Run (BGR) mainstem within ALPO between the upstream and downstream ALPO property boundaries in the following pattern: 1) only brown trout were captured at the downstream-most site, 2) only brook trout were captured at the upstream-most site above Blair Gap Reservoir, and 3) both brook and brown trout were captured at all sites in between. Due to the potential for negative effects of brown trout on brook trout, this pattern warranted additional sampling to determine the upstream limit of overlap between wild brook and brown trout populations in BGR. Because only brook trout were captured in ALPO above the Blair Gap Reservoir (the reservoir is not on ALPO property), it was hypothesized that the impoundment provided a barrier to upstream movement of nonnative brown trout.

The Sheeder and Tzilkowski (2006) survey also revealed possible discrepancies between the condition of BGR trout populations and Pennsylvania Fish and Boat Commission (PAFBC) management of trout fisheries as well as Pennsylvania Department of Environmental Protection (PADEP) designated uses of the waterway. The primary intent of this study was to determine the upstream extent of brown trout in BGR. Findings from this study, in combination with results of the Sheeder and Tzilkowski (2006) survey were then used to preliminarily evaluate the potential for BGR to: 1) be classified as a Class A wild trout stream and 2) have its PADEP protected water uses redesignated to more stringent levels for aquatic life protection. Both of these designations would help the NPS preserve brook trout on ALPO property and maintain water quality needed to support this, and other species that are sensitive to human perturbations.

Current Management of Blair Gap Run

In Pennsylvania, the PAFBC has the mission to "…provide fishing and boating opportunities through the protection and management of aquatic resources" (PAFBC 1997); consequently, that agency has jurisdiction over aquatic organisms in Pennsylvania water bodies including trout and trout stocking. The PAFBC manages BGR, including the area in and around ALPO, as an Approved Trout Water (ATW; Figure 1), and under that designation, annually stocks legally harvestable (> 17.8 cm; 7") rainbow trout (*Oncorhynchus mykiss*), brown trout, and brook trout to "…provide recreational fishing opportunity" (PAFBC 2006 a) in BGR from the Muleshoe Reservoir, downstream to 0.6 km upstream of its mouth (2006 b). Adams Run and Blair Run are

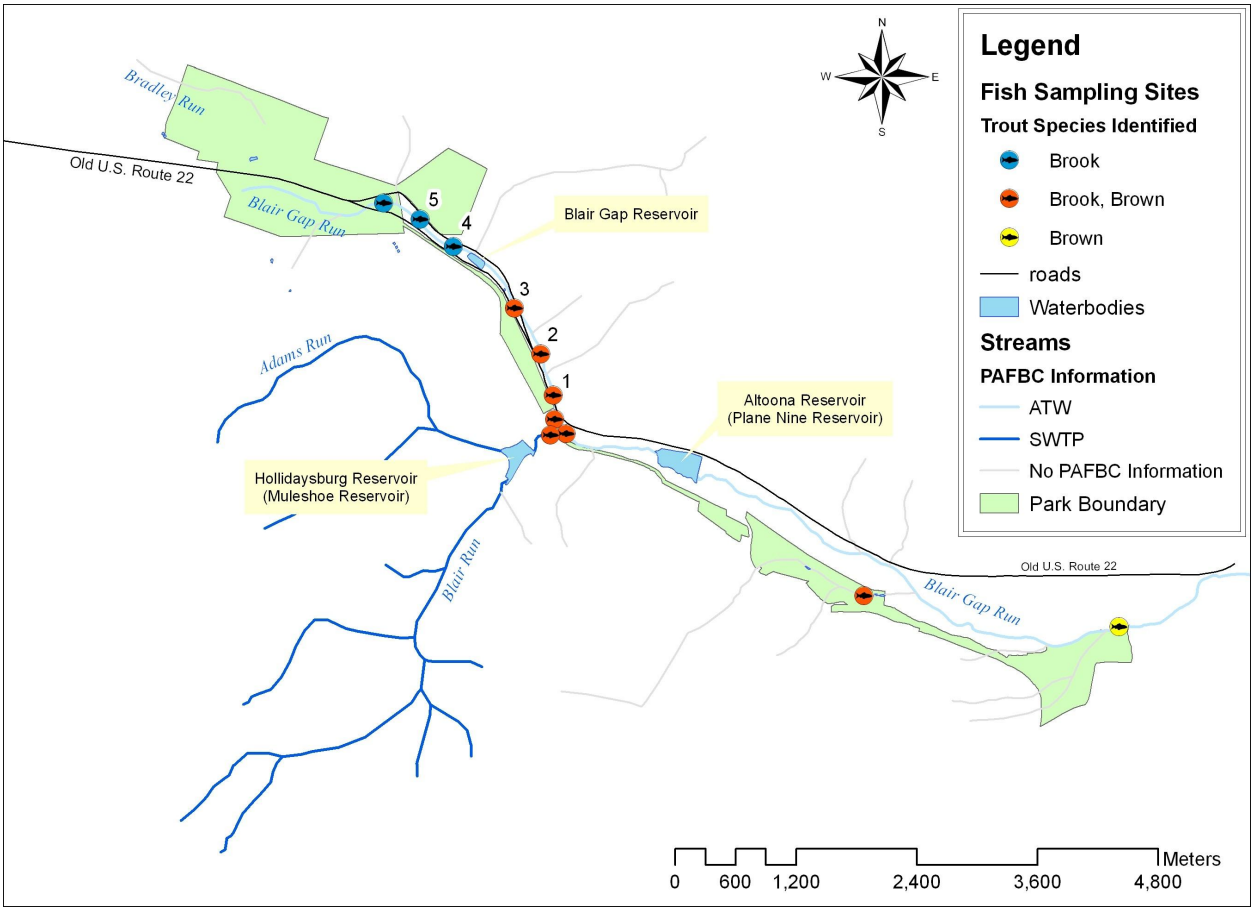

Figure 1. Pennsylvania Fish and Boat Commission (PAFBC) management designations of Blair Gap Run within and adjacent to Allegheny Portage Railroad National Historic Site. Color-coded fish sampling site markers denote where brook and brown trout were captured during 2005 and 2006 whereas numbered sites (1-5) correspond to sites surveyed during this study. ATW = Approved Trout Water, SWTP = Stream Sections that Support Wild Trout Production.

tributaries to BGR upstream of the Muleshoe Reservoir that are listed as Stream Sections that Support Wild Trout Production (PAFBC 2005) and not stocked. Conversely, BGR is not listed as a Stream Sections that Support Wild Trout Production.

Streams can be designated as Class A trout waters if they meet established biological criteria (Table 1) and are subsequently not supposed to be stocked with trout because they are capable of providing a desirable fishery without stocking (PAFBC 1997). The motivation behind designation of Class A wild trout waters is to provide anglers the opportunity to catch and harvest wild trout from populations sustained totally by natural production (PAFBC 1997). According to PAFBC (1997), specific objectives of the Class A wild trout management option are to:

1. Protect wild trout populations from harmful effects of stocking due to interactions with hatchery trout.

2. Minimize potential for over-harvest of wild trout due to attraction of anglers through stocking.

3. Maintain standing stocks of wild trout at Class A biomass levels. An increase of age-3 or older trout by a factor of two after cessation of stocking is desirable; however, habitat quantity, fishing mortality, and climatic effects on populations may limit response in older fish and is not considered a rigid measure of program success.

4. Protect habitat and water quality via public education and by seeking the highest water quality standards possible.

5. Disseminate information to other Commonwealth regulatory agencies.

The PADEP mission is "…to protect Pennsylvania's air, land and water from pollution and to provide for the health and safety of its citizens through a cleaner environment" (PADEP 2006). To that end, PADEP has established chemical and physical water quality standards (Table 2) for Commonwealth surface waters that are based on, and protected according to, protected water uses that correspond to types of aquatic life (25 Pa. Code §93.3). The protected uses of BGR are Trout Stocking (TSF) downstream of the Plane Nine Reservoir and Cold Water Fishes (CWF) upstream of that reservoir (Figure 2). The TSF and CWF protected water uses are defined (25 Pa. Code §93) as:

1. TSF – Maintenance of stocked trout from February 15 to July 31 and maintenance and propagation of fish species and additional flora and fauna that are indigenous to a warm water habitat.

2. CWF – Maintenance or propagation, or both, of fish species including the family Salmonidae and additional flora and fauna that are indigenous to a cold water habitat.

If a water body meets CWF criteria, it may qualify as a High Quality Water (HQ) or Exceptional Value Water (EV). These designations afford the greatest level of water quality protection by the PADEP and are based on meeting higher chemical and/or biological criteria than CWF. To qualify as a HQ-CWF via chemical attributes, the water has long-term water quality, based on at

Table 1. Biomass criteria used by the Pennsylvania Fish and Boat Commission for assignment of Class A Wild Trout Water designations (PAFBC 1997). All criteria within subcategories must be met to receive designation.

Management Option	Criteria
Wild brook trout	Brook trout biomass $\geq$ 30 kg/ha
	Biomass of brook trout less than 15 cm total length $\geq$ 0.1 kg/ha
	Brook trout biomass must be $\geq$ 75% of total trout biomass
Wild brown trout	Brown trout biomass $\geq$ 40 kg/ha
	Biomass of brown trout less than 15 cm total length $\geq$ 0.1 kg/ha
	Brown trout biomass $\geq$ 75% of total trout biomass
Mixed brook and brown trout	Combined brook and brown fisheries trout biomass $\geq$ 40 kg/ha
	Brook trout biomass $\leq$ 75% of total trout biomass
	Brown trout biomass $\leq$ 75% of total trout biomass
	Biomass of brook trout less than 15 cm total length of at least 0.1 kg/ha
	Biomass of brown trout less than 15 cm total length of at least 0.1 kg/ha

Table 2. Pennsylvania alkalinity, dissolved oxygen (DO), and pH criteria for the protection of aquatic life (PADEP, 2003). Water quality parameter, protected use, and criteria are presented. Aquatic life protected uses include Cold Water Fishes (CWF), Trout Stocking (TSF), Warm Water Fishes (WWF), and Migratory Fishes (MF).

Parameter	Protected Use	Criteria
Alkalinity	CWF, WWF, TSF, MF	Minimum 20 mg/L as $CaCO_3$, except where natural conditions are less
DO	TSF	For the period of February 15 to July 31, minimum 5.0 mg DO/L. Minimum of 4.0 mg DO/L remainder of the year
	CWF	Minimum of 5 mg DO/L
pH	CWF, WWF, TSF, MF	6.0 to 9.0

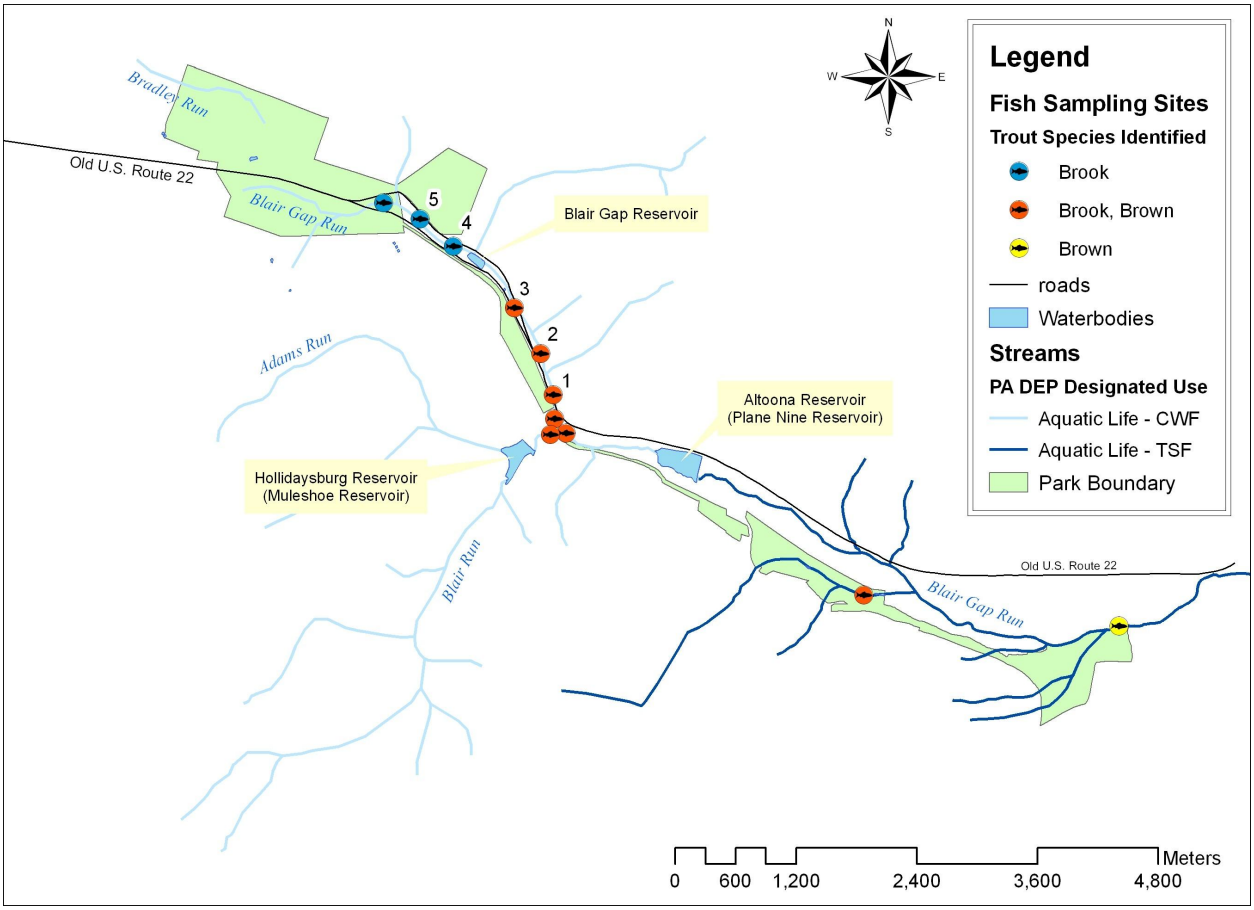

Figure 2. Pennsylvania Department of Environmental Protection (PADEP) designated protected uses of Blair Gap Run within and adjacent to Allegheny Portage Railroad National Historic Site. Color-coded fish sampling site markers denote where brook and brown trout were captured during 2005 and 2006 whereas numbered sites correspond to sites surveyed during this study. CWF = Cold Water Fishes; TSF = Trout Stocking.

least one year of data that exceeds levels necessary to support the propagation of fish, shellfish, and wildlife and recreation in and on the water by being better than established water quality criteria for 19 parameters, 99% of the time (25 Pa. Code §93.4.b.a.1.i). In addition to those criteria, "The Department may consider additional chemical and toxicity information, which characterizes or indicates the quality of water, in making its determination" (25 Pa. Code §93.4.b.a.1.ii). Surface waters may also qualify as HQ waters by meeting either of two biological qualifiers (25 Pa. Code §93.4.b). The "biological assessment qualifier" requires the surface water to support a high quality aquatic community based upon information gathered using peer-reviewed biological assessment procedures that consider physical habitat, benthic macroinvertebrates, or fishes. The "Class A wild trout stream qualifier" states that "The surface water has been designated a Class A wild trout stream by the Fish and Boat Commission following public notice and comment" (25 Pa. Code §93.4.b.a.2.ii). The EV designation is reserved for surface waters that are "…of exceptional ecological significance" or meet HQ requirements and one or more of the following:

1. The water is located in a National wildlife refuge or a State game propagation and protection area.

2. The water is located in a designated State Park natural area or State forest natural area, National natural landmark, Federal or State wild river, Federal wilderness area or National recreational area.

3. The water is an outstanding National, State, regional or local resource water.

4. The water is a surface water of exceptional recreational significance.

5. The water achieves a score of at least 92% (or its equivalent) using the methods and procedures described in subsection (a)2(i)(A) or (B).

6. The water is designated as a "wilderness trout stream" by the Fish and Boat Commission following public notice and comment" (25 Pa. Code §93.4.b)

Although fisheries management activities and water quality criteria are established and regulated by independent agencies (i.e., PAFBC and PADEP), their classifications are interrelated to varying degrees. For example, a stream designated as a TSF by PADEP is not necessarily stocked with trout by the PAFBC. On the other hand, if the PAFBC has designated surface water as a Class A wild trout water, PADEP can designate it as a HQ-CWF (25 Pa. Code §93.4.b.2.ii) which would afford the stream greater protection in the form of more stringent regulations than as only a CWF.

Methods

Trout and water quality sampling locations were selected based on results of the recent ALPO water quality, fish, and macroinvertebrate survey (Table 3 and Figure 1; Sheeder and Tzilkowski 2006). In that survey, brook trout and brown trout were found as far upstream as the confluence of Blair Run and BGR. Because the primary intent of this study was to determine the upstream extent of brown trout in BGR, trout population estimates were conducted once at five sites in BGR above its confluence with Blair Run on April 26, 2006. All sites occurred on a section of BGR owned by the Altoona City Water Authority between BGR sections flowing through NPS property (permission for sampling granted by Mark Perry, General Manager, Altoona City Water Authority). Basic water quality measurements (temperature, conductivity, dissolved oxygen, pH) were taken prior to electrofishing surveys whereas stream length and width measurements of sampled reaches were recorded after electrofishing on the same day.

Trout were captured from stream reaches bounded by impediments to fish passage (i.e., waterfalls, cataracts) by a three-person team using the Zippin (1958) three-pass depletion method. The Zippin method uses a minimum of three consecutive electrofishing passes and linear regression to estimate fish densities. If conducted properly, fewer fish are captured on successive passes. Trout were identified and counted after each pass, held in plastic buckets until subsequent passes were completed, and then released back into reaches from where they were captured. With these data, probabilities of fish capture and fish abundance estimates were made. Trout were not measured or weighed during this study to minimize handling time and risk of fish injury. Trout density estimates were calculated based upon trout abundance and area of sampled stream reaches.

Table 3. Surveyed Blair Gap Run location descriptions (downstream limit), dimensions, and locations (UTM coordinates).

Site	Downstream Limit	Width - Length (m)	Area (ha)	UTM East - North
1	75 m upstream of confluence with Blair Run	4.5 – 105	0.05	710248.5 - 4478856.3
2	250 m upstream of site 1	4.0 - 67	0.03	709888.9 - 4479328.0
3	At pulloff along old Rt. 22, ~ 2 km upstream of site 1	4.5 - 68	0.03	709930.0 - 4479973.8
4	Upstream of Altoona Water Authority sampling point # 45 marker	3.0 - 75	0.02	709305.3 - 4480556.6
5	200 m upstream of site 4	3.0 - 63	0.02	708964.9 - 4480828.5

Results

Wild-spawned trout (Figure 3) were found at all sites surveyed in and around ALPO during this study and the Sheeder and Tzilkowski (2006) inventory. Brook trout were captured at all five sites whereas brown trout were not captured or seen above the Blair Gap Reservoir (sites 4 and 5); moreover, brown trout were less abundant than brook trout at sites where they were found together (Table 4). These findings were consistent with those of Sheeder and Tzilkowski (2006).

Although BGR is not designated as a TSF upstream of the Plane Nine Reservoir (25 Pa. Code § 93.9n), it is considered an ATW. The PAFBC reportedly stocked trout upstream of that reservoir to the Muleshoe Reservoir (i.e., BGR confluence with Blair Run) during 2006 (PAFBC 2006 b). All sampling locations during this survey were upstream of where PAFBC reportedly stocked trout in 2006, but it is possible that trout migrate upstream (between reservoirs) in BGR if stream flows allow fish passage. Hatchery-reared trout generally retain a pale coloration and often have deformed fins for several weeks after being stocked. Based on trout appearance, no trout stocked during 2006 were caught during these surveys.

Physical characteristics and water quality parameters were similar among sampled reaches (Table 5) and were within acceptable limits for CWF designation (Sheeder and Tzilkowski 2006). The only possible difference among sites was that conductivity measurements upstream of the Blair Gap Reservoir (sites 4 and 5) were nearly twice as high of those downstream of the reservoir (Sites 1, 2, and 3). As reported by Sheeder and Tzilkowski (2006), reservoirs on BGR likely lower downstream conductivity by allowing dissolved substances to fall out of suspension.

Figure 3. Wild-spawned brook trout from Blair Gap Run (BGR) headwaters (top left), wild spawned brown trout from downstream limit of ALPO property (top right), and wild spawned brook trout and brown trout from BGR near its confluence with Blair Run (bottom).

Table 4. Number of brook trout and brown trout individuals (I) captured and estimates of trout density (D = individuals/m^2) at five Blair Gap Run sites upstream of Blair Run.

	Brook trout		Brown trout	
Site	I	D (95% CI)	I	D (95% CI)
1	23	0.07 (0.04, 0.10)	5	*
2	7	0.03 (0.01, 0.05)	3	*
3	30	0.11 (0.02, 0.21)	9	*
4	23	0.11 (0.10, 0.12)	0	0
5	33	0.19 (0.12, 0.26)	0	0

*Assumptions for the Zippin (1958) method were not met for calculation of 95 % CI.

Table 5. Chemical characteristics of stream reaches surveyed for trout densities in Blair Gap Run upstream of Blair Run. T = water temperature, DO = dissolved oxygen.

Site	T (^oC)	pH	DO (mg/L)	DO (%)	Conductivity (µs/cm)	Specific Conductivity (µs/cm)
1	7.6	7.65	11.38	95.8	112.1	166.6
2	8.9	7.33	11.39	98.9	115.0	164.8
3	9.9	7.36	10.66	95.1	124.6	174.1
4	9.6	7.57	10.63	93.4	212.9	301.6
5	9.5	7.48	10.99	96.7	215.8	306.7

Discussion

This survey and the recent Sheeder and Tzilkowski (2006) inventory suggested that: 1) BGR supports naturally reproducing brook trout and/or brown trout populations from its headwaters to the downstream limits of ALPO property, and 2) upper BGR (i.e., upstream of the area that PAFBC stocks with trout) has stream reaches with brook trout populations that may meet Class A wild trout water criteria. Results of these studies have several implications regarding PAFBC management options in BGR and their potential effects on preserving native brook trout at ALPO; moreover, portions of BGR likely deserve redesignation of their PADEP protected uses which would afford greater water quality protection.

The NPS is attempting to reestablish native brook trout in the Great Smoky Mountains National Park by: 1) using electrofishing to eradicate brown trout and rainbow trout (Moore et al. 1983), 2) transplanting brook trout from local populations and 3) allowing harvest of salmonids except for brook trout. Other parks, such as Yellowstone National Park, manage some established nonnative salmonid species (e.g., brown trout) for recreation while eradicating others (e.g., lake trout); however, most parks and states no longer introduce exotic species for recreation (Moore et al. 1983, Benhke 2002). Eradication of brown trout is very unlikely to occur in or near ALPO given: 1) the size of the BGR watershed, 2) the importance of BGR as a water supply for urban centers, and 3) the economic and logistical difficulties of such efforts; consequently, if preserving native brook trout is a goal in BGR, preventative measures in the form of best management practices are the only likely option.

The PAFBC manages trout fisheries based upon social (e.g., angler pressure) and biological factors. According to the PAFBC (2006 c), "If there are enough wild trout naturally occurring in a waterway to support fishing pressure, then that waterway isn't stocked. Waters that have some wild trout, but not enough to support high fishing pressure, are good candidates for stocking." Streams must meet several criteria related to biomass of resident trout species to have "enough" wild trout to be called Class A wild trout waters and not be stocked. The PAFBC criterion regarding biomass of small trout ($\leq$ 15 cm) is a measure of successful trout reproduction. Because trout were not measured during this study, it was not possible to quantify whether trout populations met this criterion; however, wild-spawned ($\leq$ 15 cm) brook trout were abundant at all sites (*personal observation*). Wild-spawned brown trout were caught at only sites 1 (one individual) and 3 (two individuals) during this survey, but they recently were found at all sites downstream of Blair Run by Sheeder and Tzilkowski (2006). Brown trout were less abundant than brook trout at sites 1, 2, and 3 and were not captured or seen above the Blair Gap Reservoir in this survey (Table 4) or in the recent survey (Sheeder and Tzilkowski 2006). Estimates of brook trout density were greater upstream of Blair Gap Reservoir (sites 4 and 5) in the absence of brown trout than at downstream sites where brown trout were captured.

Early conservationists (Winter 1931) and researchers (MacKay 1957) recognized that brown trout displaced brook trout, but the mechanisms involved are complex and still not thoroughly understood. Brook trout historically occurred virtually everywhere in Pennsylvania that brook trout or brown trout currently occur, except for downstream areas that have at least marginal brown trout habitat, but never provided suitable brook trout habitat (Kocovsky 2004). Brown trout have been stocked in downstream reaches of nearly every suitable Pennsylvania trout

stream; thus, the absence of brown trout in potential streams is attributable to interactions among stream-specific biotic and abiotic factors and the presence of barriers (e.g., natural or manmade), not to a lack of stocking (Kocovsky 2004).

A longitudinal gradient of brook and brown trout populations is typical in streams where they are sympatric; brown trout dominate downstream sections, followed by a middle zone of coexisting brown and brook trout, and only brook trout in headwaters. This pattern of brook trout and brown trout longitudinal distribution has been attributed to an interaction among: 1) abiotic stream conditions (Gard and Flittner 1974, Rahel and Hubert 1991, Taniguchi et al. 1998, Kocovsky 2004), 2) competition (Nyman 1970, Fausch and White 1981), 3) reproductive interactions between the species (Sorensen et al. 1995), 4) greater susceptibility of brook trout than brown trout to angling (Cooper 1952), and 5) predation on brook trout by large brown trout (Alexander 1977) and terrestrial predators (Alexander 1976).

Because trout were not weighed during this study, it was not possible to definitively determine whether BGR trout populations met PAFBC Class A wild trout water criteria. Trout density and biomass estimates were calculated in a recent study (Tzilkowski 2005) conducted in two central Pennsylvania streams (Tomtit Run, Lingle Run) that were classified as Class A mixed wild brook and brown trout waters. Brown trout density in BGR was significantly lower than in the two other Class A streams but brook trout densities in BGR were similar to those in Lingle Run (Figure 4). These results suggest that BGR may qualify as a Class A brook trout stream but probably not as a Class A mixed brook and brown trout water.

Implications for Management of Blair Gap Run Trout Populations

Because wild-spawned trout were captured at all sites during this and a recent survey (Sheeder and Tzilkowski 2006), BGR within and near ALPO should be listed as a Stream Section that Supports Wild Trout Production by the PAFBC. A more thorough survey by the PAFBC may justify changing BGR management upstream of the Plane Nine Reservoir from an ATW to a Class A wild trout water.

It is difficult to assign a single cause to the typical distribution pattern of sympatric brook and brown trout, but because brown trout have been propagated and established so successfully, brown trout are implicated as a primary cause of native brook trout declines (Fausch and White 1981; Behnke 2002). Given that some NPS parks are mechanically and chemically removing exotic salmonids in an effort to preserve native ones, introducing nonnative trout in and around ALPO waters is almost certainly counterproductive to brook trout preservation. Termination of trout stocking in parts of BGR would likely aid the NPS goal of preserving native species (i.e., brook trout) while modification of harvest regulations would probably continue to provide a rewarding recreational fishery in BGR.

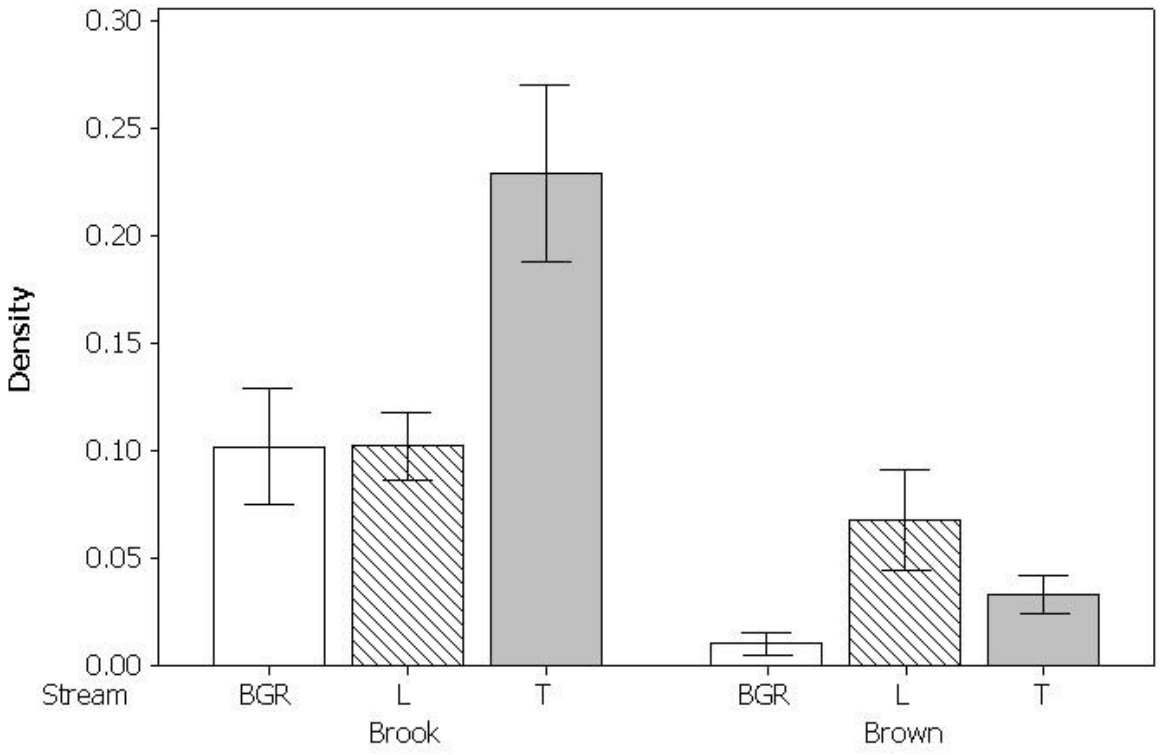

Figure 4. Average (± 1 SE) density (individuals/m^2) of brook and brown trout in Blair Gap Run (BGR) and two other central Pennsylvania streams (L = Lingle Run, T = Tomtit Run; Tzilkowski 2005) that were classified as mixed wild brook and brown trout fisheries by the Pennsylvania Fish and Boat Commission.

Implications for Blair Gap Run Water Quality Regulation

BGR downstream of the Plane Nine Reservoir propagated "…fish species including the family Salmonidae…" thus, that stream section qualified for redesignation by PADEP from TSF to CWF which would provide more stringent water quality regulation. If the PAFBC decides that BGR upstream of the Plane Nine Reservoir deserves Class A wild trout water designation, that stream section could be redesignated as a HQ-CWF by the PADEP which would afford it increased water quality protection.

Management Recommendations

Based on results of this study and the inventory conducted by Sheeder and Tzilkowski (2006), it is recommended that the NPS cooperate with PADEP and PAFBC to:

1. List BGR from its headwaters to the downstream limit of ALPO as a PAFBC – Stream Section that Supports Wild Trout Production.

2. Change the PADEP Protected Use of BGR from Trout Stocking to Cold Water Fishes, from the Plane Nine Reservoir to the downstream boundary of ALPO.

3. Investigate the potential of BGR trout populations, primarily upstream of Blair Run, to meet PAFBC Class A wild trout water criteria.

4. If sections of BGR meet PAFBC Class A wild trout water criteria, they should be designated as such, which would also satisfy PADEP criteria for the protected use of those sections to be designated as High Quality Cold Water Fishes.

5. Minimize the potential for detrimental effects of hatchery trout on native brook trout by limiting trout stocking in BGR to below the Plane Nine Reservoir.

Literature Cited

Alexander, G. R. 1976. Diet of vertebrate predators on trout waters in north central Lower Michigan. Michigan Department of Natural Resources Fisheries Report 1839. 18p.

_____. 1977. Consumption of small trout by large predatory brown trout in the North Branch of the Au Sable River, Michigan. Michigan Department of Natural Resources Fisheries Report 1855. 26pp.

Behnke, R. J. 2002. Trout and salmon of North America. The Free Press, New York, NY.

Cooper, E. L. 1952. Rate of exploitation of wild eastern brook trout and brown trout populations in the Pigeon River, Otsego County, Michigan. Transactions of the American Fisheries Society. 81:224–234.

Fausch K. D., and R. J. White. 1981. Competition between brook trout (*Salvelinus fontinalis*) and brown trout (*Salmo trutta*) for positions in a Michigan stream. Canadian Journal of Fisheries and Aquatic Science 38:1220–1227.

Gard, R., and G. A. Flittner. 1974. Distribution and abundance of fishes in Sagehen Creek, California. Journal of Wildlife Management 39:347–358.

Kocovsky, P. M. 2004. Predicting density and biomass of wild brook trout and brown trout in Pennsylvania streams using landscape- and reach-scale factors. Ph. D. Dissertation. The Pennsylvania State University, University Park, PA. 188pp.

Lassuy, D. R. 1995. Introduced species as a factor in extinction and endangerment of native fish species. American Fisheries Society Symposium 15:391–396.

MacKay, H. H. 1957. The brown trout. Sylva 13(2):25–31.

Moore, S. E., Bromfield, R., and G. L. Larson. 1983. Standing crops of brook trout concurrent with removal of rainbow trout from selected streams in Great Smoky Mountains National Park. North American Journal of Fisheries Management 3:72–80.

Nyman, O. L. 1970. Ecological interaction of brown trout, *Salmo trutta* L., and brook trout *Salvelinus fontinalis* (Mitchell), in a stream. Canadian Field Naturalist 84:343–350.

PAFBC. Pennsylvania Fish and Boat Commission. 1997. Management of trout fisheries in Pennsylvania waters. Division of Fisheries Management, Bureau of Fisheries. http://sites.state.pa.us/PA_Exec/Fish_Boat/trman98.htm#I.%20TROUT%20FISHERIES%20IN. Accessed July 21, 2006.

_____. 2005. Pennsylvania stream sections that support wild trout production-2005. (http://sites.state.pa.us/PA_Exec/Fish_Boat/trout_repro2005.pdf). Accessed July 21, 2006.

_____. 2006 a. 2006 Adult trout stocking. http://sites.state.pa.us/PA_Exec/Fish_Boat/stocking/counties/blai.htm. Accessed July 21, 2006.

_____. 2006 b. Trout stocking 2006. http://sites.state.pa.us/PA_Exec/Fish_Boat/stock.htm. Accessed July 21, 2006.

_____. 2006 c. The science of stocking trout. http://sites.state.pa.us/PA_Exec/Fish_Boat/stock.htm. Accessed July 23, 2006.

PADEP. Pennsylvania Department of Environmental Protection. Mission Statement. http://www.depweb.state.pa.us/dep/cwp/view.asp?a=3&q=461254. Accessed September 20, 2006.

Rahel, F. J., and W. A. Hubert. 1991. Fish assemblages and habitat gradients in a Rocky Mountain-Great Plains Stream: biotic zonation and additive patterns of community change. Transactions of the American Fisheries Society. 120:319–332.

Sheeder, S. A. and C. J. Tzilkowski. October 2006. Level I Water Quality Inventory and Aquatic Biological Assessment of The Allegheny Portage Railroad National Historic Site and The Johnstown Flood National Memorial. Technical Report NPS/NER/NRTR - 2006/060. National Park Service, Northeast Region. Philadelphia, PA.

Sorensen, P. W., Cardwell, J. R., Essington, T., and D. E. Weigel. 1995. Reproductive interactions between sympatric brook and brown trout in a small Minnesota stream. Canadian Journal of Fisheries and Aquatic Sciences 52:1958–1965.

Taniguchi, Y., Rahel, F. J., Novinger, D. C., and K. G. Gerow. 1998. Temperature mediation of competitive interactions among three fish species that replace each other along longitudinal stream gradients. Canadian Journal of Fisheries and Aquatic Sciences 55:1894–1901.

Tzilkowski, C. J. 2005. Native brook trout and naturalized brown trout effects on two Pennsylvania headwater stream food chains. Ph. D. Dissertation. The Pennsylvania State University, University Park, PA. 200 pages.

Winter, R. B. 1931. Preservation of our brook trout. Pages 9 – 14 *in* C. Lose, Vanishing trout. The Times Tribune Co., Altoona, PA.

Zippin, C. 1958. The removal method of population estimation. Journal of Wildlife Management 22:82-86.

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